Atlas Copco Canada Ltd.

Atlas Copco

compressed air comments

May 1963, Volume 6, Number 2

Special in This Issue

- Bubbler Battles Sea Water
- Blue Mesa Dam
- Swedish Labor Practices
- Lighthouse at Tadoussac

OVERBURDEN DRILLING

The method of drilling and blasting without removing overburden is relatively new in industry but already it has proved effective in a variety of time and money-saving applications. Because of mounting interest, the text of a talk on the subject given by T. K. Norbury of Atlas Copco at the Diamond Drilling Convention in Toronto in early March is reproduced in this issue. *Voirie et Construction* photo at right shows overburden drilling rigs in action at the Manicouagan 2 diversion tunnels in Quebec.

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May 1963, Vol. 6 No. 2

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745 Montreal-Toronto Blvd., Dorval, P.Q.

Dear Sir:

Industrial organizations have one distinct advantage over the individuals who comprise them: unlike the mortal individual who inevitably grows old and weary, a company grows old — but it need not grow weary. It can renew itself constantly with new people and new ideas.

This fact becomes evident in relation to Atlas Copco, which celebrates its 90th birthday this year. The ancestor of the present organization opened for business in Stockholm in 1873. It was almost a quarter of a century later that it got into the compressed air business, and it was many years later that it dropped all other interests to concentrate solely on the development of compressed air equipment. In the process, it became the world's largest manufacturing organization devoted exclusively to this field.

Although the use of compressed air is rather ancient, the last few years have seen many advances in its useful applications in industry. As a senior organization in the field, Atlas Copco has contributed greatly to those developments. In spite of nearing the century mark, the organization will not grow old as long as young men, young ideas and imagination remain an integral part of the Company.

The Editor

Air lines

Most people are aware that the past winter was extremely severe in Europe—as it was in many places. Such conditions are particularly onerous for people who are not always equipped—psychologically or physically — to deal with prolonged periods of cold weather. As a result, there was real distress among large segments of the human population in Europe during the past winter.

There was distress also among other creatures in Europe — particularly the wildlife. Birds that normally winter in the temperate climate of Europe found their food and water sources blanketed by impenetrable ice and snow. As a consequence, they perished by the thousands.

Europeans, however, are generally more considerate of wildlife than North Americans — and many of them did not stand idly by while disaster took its toll. One of the techniques used widely in Europe was the Atlas Copco bubbler system, which was installed in many areas to provide open food and water sources for the birds. It may be recalled that this system was developed in Sweden, and an unofficial report is that it was used first to provide winter accommodation for ducks on a Stockholm pond. In any event, it has become an established technique for fighting ice, and has many industrial applications as well.

Holland, which provides winter refuge on its ponds and canals to many northern European birds, was quick to adopt the bubbler system when picks and axes failed to provide the needed open water. The result was that thousands of birds were saved. Belgium followed soon after. The program was widely publicized in Europe.

Bubblers Help Keep Dutch Water Fresh

Atlas Copco's bubbler system has become well known in Canada for keeping docksides and waterways free of ice. Apart from these, the ingeniously simple curtain of bubbles has a host of other potential uses. Some are already being exploited. It has been used, for instance, in oxygenating stagnant water, enabling fish to survive; and as shield against shock waves from underwater explosions. Both these have been used in Canada and new applications are constantly appearing in various parts of the world.

A new and unusual use is now reported from Holland. The low-lying Netherlands — most of its territory is below sea level — has always had to battle for survival against the inflow of the sea. The bubbler system is one of the most recent weapons in this struggle.

Salt water threat

Each year when the shipping locks are opened, there is a massive inflow of thousands of tons of salt in the seaboard areas. The salt has often infiltrated the precious underground layers of fresh water. Holland's Public Works Department has been experimenting with the bubbler system to combat this pollution. Bubblers were laid in the canals to create convective movements of the underwater saline layers so that they would mix with the lower-density surface water and be carried seawards. This would largely prevent the infiltration of salt and waste into the sources of fresh water.

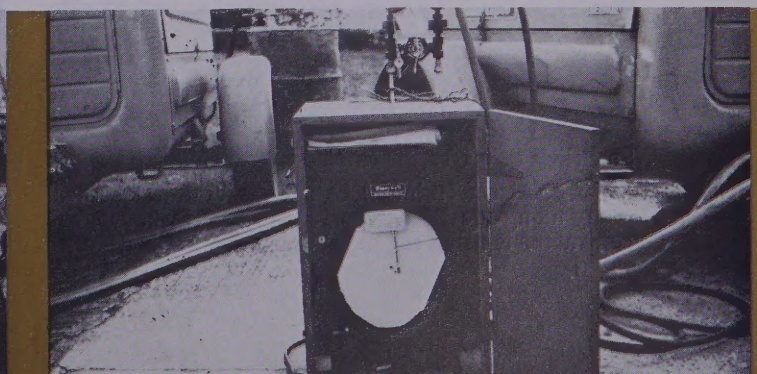
Results of these tests have been so satisfactory that other countries with similar problems regularly send observers to the Dutch demonstrations. Atlas Copco has provided the compressors for the long series of experiments.

Further tests were made to see whether the bubbler system could reduce the actual inflow of the salt water. These were carried out at the port of Terneuzen where a new lock installation is being built. A 2-in. plastic pipe with perforations 2 in. apart was sunk to the bottom of the basin of the main lock. This lay directly across the entrance to the lock gates.

Each time the gates were opened for passage of ships, six Atlas Copco VT compressors pumped air through the pipes. Gauges were placed outside and inside the gates at four points to measure the density of the water through its different saline levels.

Checks were made of this system with a sensometer. This equipment, by means of electrodes at a predetermined depth, measured the degree of conductivity of the water, which increases with the saline content. The tests demonstrated that an air-bubble curtain could greatly reduce the inflow of saline water.

The bubbler curtain (top left) impedes salt infiltration, preventing a wedge of high density saline water being formed in the lock. A cargo ship plows through the curtain at the Dutch port of Terneuzen. Careful measurement is made to determine the rise in density, hence the amount of sea water entering the locks when a ship passes through the compressed air bubbles. Satisfactory results have been obtained with this simple and inexpensive technique. Record is made by a chart of the exact amount of air used by the bubbler system during sealing off of the locks.



OVERBURDEN DRILLING

Canada and the World

The plug separating two tunnels of Quebec-Hydro's 6 million hp Manicouagan power project from the river was blown in January of this year — exactly on schedule — thanks to the overburden drilling method and Atlas Copco equipment. The two diversion tunnels at the Manic 2 section of the project had been completed, and drilling of 4-in. holes to remove the plug was required through 6 - 20 ft. of ice, water and mud overburden.

Ordinary methods of drilling were used in some sections, but in key parts they would have been too slow, and the delay would have thrown the project behind schedule. Holes were drilled using Atlas Copco BVB31 and BVB61 overburden drilling machines, and the blast went on schedule.

Overburden drilling — a method of drilling and blasting without removing the overburden — was used for the first time in Canada in 1962 in drilling and grouting for a coffer dam at Manic 5, another power station in the same project. As well, it was used in Canada in 1962 during the construction of a foundation retaining wall for Montreal's new cultural center, Place des Arts.

Overburden drilling was originally developed for the Lindo Canal project in Sweden in 1960. It has since been used for a wide variety of purposes in Australia, Ghana, Belgium, Israel, Spain, France, Bolivia and Sweden, as well as Canada.

Fast and economical

The method drives through subsoil and boulders — and also under water — to and through bedrock at faster penetration rates and more economically than by other methods. The technique requires special equipment—Atlas Copco rock drills with powerful independent rotation, chain feeds and Sandvik Coromant special drill pipes and standard extension steels.

OD around the world

Italy: Six BVB31 units are currently being used in drilling for underwater blasting for three quays in Genoa harbor. With an average drilling depth to bedrock of 26 ft., 3,500 holes were drilled in two months last fall, for a total drilling of 92,000 ft.

Bolivia: Interesting trials are being made in prospecting for tin embedded in moraine. The plan is to drill with the 2¾-in. OD equipment, letting the cuttings flush up between the inner steel and the outside pipe. Sampling of the soil is carried out during drilling.

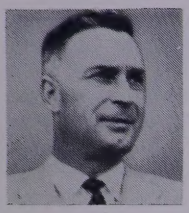
France: At the Rhinau lock and power system, one of many along the Rhine from Basel to Strasbourg, the contractor is using the overburden drilling method to inject cement under the concrete bed at the water inlet for the plant. With the method used previously, the contractor was able to drill only 4 ft. per hour. By using overburden equipment, he increased performance to 13 - 16 ft. per hour.

At Montreal's Place des Arts, holes for foundation grouting were drilled by Atlas Copco BBE51 unit using the overburden drilling method.

Ghana: In the Volta River power project, the overburden drilling method was used successfully in blasting the inlet to the diversion tunnel. Blasting for the outlet tunnel, in which other machines were used, was not a success because a large portion of bedrock below the water remained after the blast and had to be removed. It was subsequently drilled and blasted without difficulty with a raft-mounted overburden drilling rig.

Israel: For the enlargement of Haifa harbor, one contractor is using the overburden drilling method. The maximum depth of water after cleaning out the blasted rock must be 36 ft. To save time it was found convenient to drill without dismantling rods and pipes, and therefore a 50-ft. tower was built, holding 40 ft. of 2¾-in. drill equipment. The tower was mounted on a four-wheel platform on which winches and controls were fitted. This rig was mounted on a pontoon, where it could be moved lengthwise in guide channels; five holes could be drilled without moving the pontoon. Average capacity for one month was 30 holes.

South Africa: At the West Driefontein Gold Mine the overburden drilling method is being used in an operation to avert further disastrous sinkholes, such as one which occurred in 1962 when a crushing plant was lost. Beside the mine's huge winding engine house, a hole was drilled to a depth of 426 ft. — the first 96 ft. by the overburden drilling method. The steels were removed and a 1-in. pipe was sunk. After the casings were withdrawn, a 96-ft., 2-in. pipe collared the hole. The 1-in. pipe, which was firmly grouted at its lower 15 ft., projects above the 2-in. pipe. Slippage of the 1-in. pipe into the 2-in. pipe will give instant warning of subsidence and that the area should be evacuated at once.



Overburden Drilling Method Important to Diamond Drillers

by T. K. Norbury

Although the overburden drilling method was introduced only three years ago, word of its advantages and its successes has spread quickly throughout the world. Because of its growing importance in construction as well as other industries, we believe many readers of this publication would like to examine some of the technical aspects of the subject. We are pleased to reproduce this semi-technical article which was presented by the head of the diamond drilling department of Atlas Copco Canada Ltd., to the recent annual meeting of the Canadian Diamond Drilling Association in Toronto.

Work of the diamond driller is concentrated primarily with the art and science of recovering core samples. He endeavors to improve equipment used in drilling rock to take a core, which is the greater part of a drilling operation. Coring bits are a target for many research dollars, core barrels have been extensively developed, even the rods and couplings have received special attention. Basically, the improvements have been made to add economies to the job of taking core samples. There is a continual striving to do a better job, in less time, and at less cost.

Footage-wise, overburden might not draw much attention but, dollar-wise, it can mean the difference between profit and loss. Without the security of cost-plus clauses, overburden can be the downfall of unfortunate contractors.

We do not propose to solve all overburden problems within a few minutes. More realistically, we can examine one drill designed specifically for overburden drilling. Manufactured by Atlas Copco AB in Sweden, it is known as the Overburden Drill.

This drill is operated entirely by compressed air. The drilling component contains a standard rock drill with a separate rotation motor. Feeding is by chain, driven by a feed motor. Hoisting is done by winches and cables passing over pulley wheels mounted on the feed beam. Swiveling of the feed beam permits holes of any angle.

Capacity is a nebulous characteristic for any machine in overburden. Under difficult conditions, including gradation from sand, gravel and some boulders, this unit may be expected to drill to 150 ft. It is not unusual to put such a hole down in less than 24 hours. Overburden pipe dimensions allow telescoping and give open holes of 4-in. and 2-in. diameters.

The overburden drilling method consists of simultaneously running an internal string of rods and an external string of pipe. Both strings connect to a common adapter which transmits hammering, rotation and feed to the tools. Individual remote controls allow separate application of either hammering, rotation or feed. The common adapter allows independent advance of either the internal or external string. For instance, the internal string may be advanced in bedrock after seating the pipe.

Down-the-hole tools

The above was a general description of the drill and its method. Following are some details:

Two sizes of down-the-hole equipment exist. The larger, nominally termed "5-inch", takes a pipe bit

CRAW (Concrete Repair & Waterproofing Ltd.), subcontractors to J. A. Auclair Ltée, used overburden drilling for ground grouting at the base of a dam to be 35 ft. high and 500 ft. wide to provide a water reservoir at Charlesbourg, P. Q. Forty feet of sand, gravel and occasional boulders separated the surface from the bedrock. Atlas Copco overburden drilling rig with 2¾-in. tools saved considerable time and money on the job.

having a 6-in. outer diameter, while pipe couplings have an inside diameter of 4⅛ in; these are the limiting dimensions of the 5-in. pipe. Its standard internal equipment is 1½-in. extension rods with a 4-in. carbide cross bit. In diamond drilling terms, the pipe will take H coring tools; and the internal bit will cut a hole also sufficient to take H coring tools.

Small-sized assembly

The smaller-sized assembly, nominally termed "2¾-inch", takes a pipe bit with 3⅝-in. outside diameter and a 2⅜16-in. inside diameter; these are the limiting dimensions of the pipe string. Standard internal equipment is 1¼-in. extension rods and a 2-in. carbide cross bit. In diamond drilling terms, the pipe will pass through H casing, or take AXT coring tools inside; and the internal bit will also cut a hole sufficient to take AXT coring tools.

The overburden drilling method with Atlas Copco equipment is at work on last phases of diversion tunnels at Manic 2, in last winter's 40° below weather. Speed of the drilling through the unstable overburden enabled the tunnels' remaining plug to be blasted away on schedule.

Water flushing requirements have been recommended at up to 45 gpm and 200 psi, using the 5-in. string. However, much less volume may be used satisfactorily in many types of overburden. Air flushing has been tried and satisfactory advance was maintained with 105 cfm at 85 psi.

Performance and capacity

Returning to depth capacity, the 5-in. string may be conservatively rated at 50 ft. It has exceeded this depth in sands and gravels. Telescoping to the 2¾-in. tools might extend the hole to 150 ft. Performance data taken from drilling in sands and gravels shows a depth of 80 ft. reached in seven hours, 110 ft. in 12 hours and 135 ft. in 21 hours. Open hole size was 2 in.; penetration rate at the bottom range was 2 ft. per hour.

A representation of bit costs may be as follows:

5-in. pipe bit	$0.50/ft.
4-in. cross bit	$0.18/ft.
2¾-in. pipe bit	$0.26/ft.
2-in. cross bit	$0.07/ft.

Drill rig components

The rock drill, known as the BBE51, has a total weight of 450 lb., and a length of 33 in. Its percussion piston has a 4¾-in. diameter. Included with the drill is the rotation motor developing 3 hp at 1,000 rpm. Gear and sprocket reduction permits rod rotation of 100, 67 or 50 rpm depending upon the size of drive sprocket in service. Air consumption while drilling is 442 cfm plus a possible 105 cfm for flushing.

Two winches are mounted on the machine, each weighing 375 lb., each develops 6.2 hp taking 175 cfm of air.

The BMM41 chain feed was developed specifically for overburden drilling. It serves as a mast, having cable pulleys for hoisting. A yoke or pipe guide at the lower end stabilizes the long lengths of pipe used in the drilling. The feed beam has sufficient length to take 15-ft. lengths of pipe, or may be reduced to take only 10-ft. lengths.

Applications

Applications of the overburden drilling method are numerous. It has a place in blasting of bedrock under a mantle of overburden, and its speed makes it well-suited to soil testing. But the prime interest to diamond drilling people is its application to diamond drilling. It is not new to have a special crew and a special drill putting holes down to the bedrock for completion by another drill. This has proved to be of economic advantage on a number of large-volume jobs.

The overburden drilling method offers great economic gains in drilling open holes into unconsolidated ground. It has found acceptance from those who have used it. Combined with the diamond driller's ingenuity and technical skill, the method may become one of the great advances in the diamond drilling industry.

Big Tunneling Savings

with Lightweight Drills

When Quad Construction Inc. of Denver, Colorado, won a sub-contract for a three-tunnel project for the Blue Mesa Dam, it counted on lightweight equipment and unorthodox methods to pull it through on schedule.

To drive 26-ft. circular diversion and 19 ft. 6 in. outlet works tunnels on the hydro and water storage project near Gunnison, Colo., Quad ignored conventional heavy drifter equipment and chose lightweight Atlas Copco pusherleg rock drills. As a result of this choice, Quad claims a drilling equipment outlay of $100,000 less than it would have required for the heavy drifter equipment.

Using tunnel-driving methods more common to hard-rock mining than to construction, Quad's engineers used the shrink-stope technique on a 330-ft. spillway tunnel on a 55° slope. Quad thus reversed the usual drilling direction; instead of jackhammering down by lifts from the top, it worked from the bottom up.

One of a group

The Blue Mesa Dam will be part of a multi-state, multi-dam complex designed by the U.S. Bureau of Reclamation to regulate and make useful the waters of the upper Colorado River and its main tributaries. Other storage units will be located in Arizona, Utah and New Mexico, and others in the area are still in the planning stage.

The V-shaped Blue Mesa earthfill dam will rise 342 ft. above the bed of the Gunnison River in a narrow canyon requiring a crest length of only 800 ft. A 19-mile-long reservoir with storage capacity of 940,800 ac. ft. will be formed, and a powerhouse will have two 30,000-kv generators.

Diversion tunnel

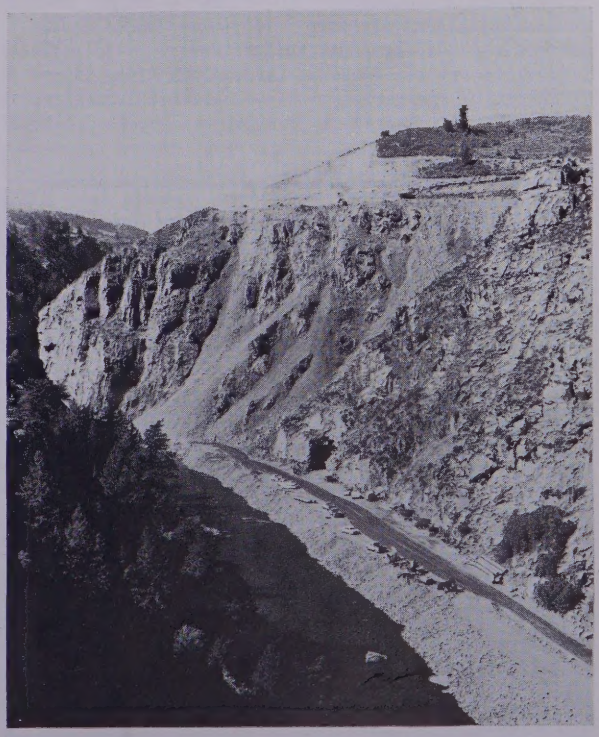
Drilling through hard, moderately-jointed granite gneiss formation, Quad required only 83 days to achieve the breakthrough on the 1,903-ft. diversion tunnel. The drive was with full-size heading — except for the final 80 ft. — and on a three-shift, six-day basis. Drill steel costs for the 34,600 cu. yd. of excavation were less than 5¢ a drill foot, and drilling machine maintenance costs were only ¾¢ a foot.

The drillers used Atlas Copco BBC23 pusherleg drills, equipped with ⅞-in. hexagonal Sandvik Coromant integral drill steels. The $1\frac{5}{16}$-in. diameter on the integral steel permits a pattern of a large number of small holes and light loads, thereby avoiding overbreak and giving good fragmentation, for faster mucking. When steels were worn, they were re-tapered on the job, fitted with "one-pass" tungsten-carbide bits, and re-used in stoper drills working the spillway raises.

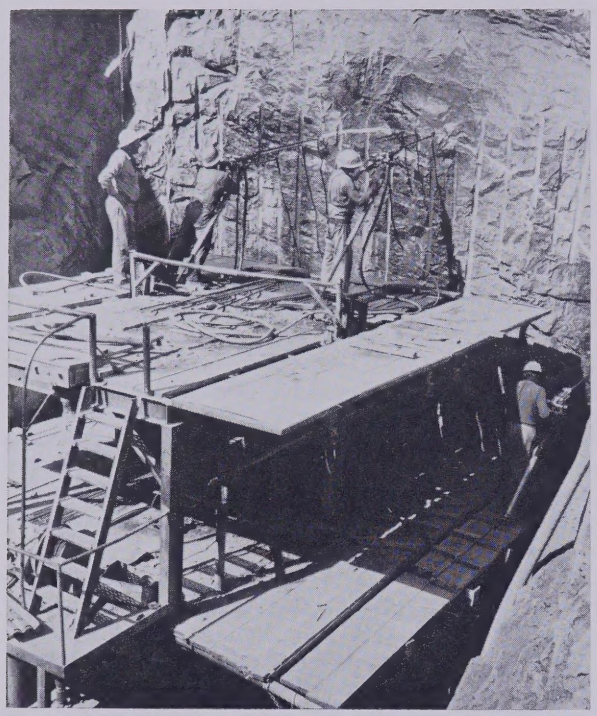
Consistent achievement of a 5-4-5 sequence of complete cycles on successive days reflects the high drilling speeds maintained in the diversion tunnel. Average drill time was 1 hour, 45 minutes for an 88-hole to 102-hole pattern of 7-ft. depth with a steel change at 5 ft. 3 in.; 45 minutes for loading and preparation; 30 minutes smoke time and $2\frac{1}{2}$ hours for mucking.

Outlet tunnel

The second-largest phase of the Blue Mesa project, the S-shaped outlet works tunnel, was drilled with the same equipment and techniques, except that a three-tiered, six-machine jumbo, mounted on an Allis-Chalmers HD16 cat, was used. This tunnel, driven from a single heading, has the first 247 ft. on the level, the next 247 ft. climbing and the final 600 ft. level again.

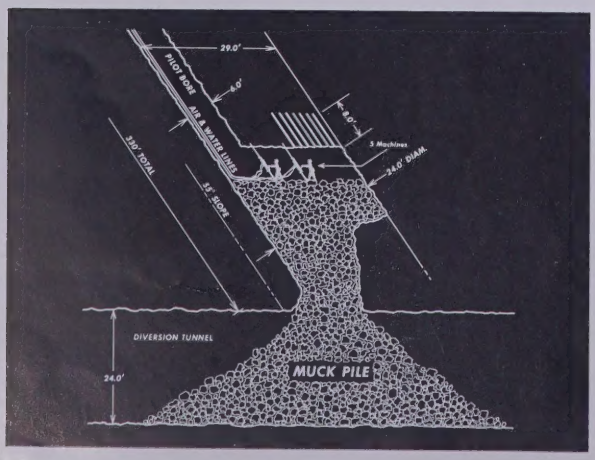


Upstream portal of diversion tunnel is visible in this general Blue Mesa scene. The dam, an earthfill structure rising 342 ft. above the Gunnison River, will be at the river bend in the background at left.



Using this comparatively light jumbo, above, drilling costs of less than 5¢ per foot were experienced by Quad Construction in driving a 26-ft. full-heading diversion tunnel at Blue Mesa. Below right: Small-diameter integral drill steel, right foreground, was used in lightweight Atlas Copco BBC23 pusherleg drills. Seven machine crews were able to drill out 88 to 102-hole patterns of 7-ft. holes in 1 hr. 45 min.

Sketch below shows how miners used the shrink-stope technique to drive the 55°-slope spillway raise. Drilling from the bottom up with stoper drills is the reverse of the usual construction method of jackhammering down from the top by lifts, for a shaft of this dimension. Five stoping drill machines were used.

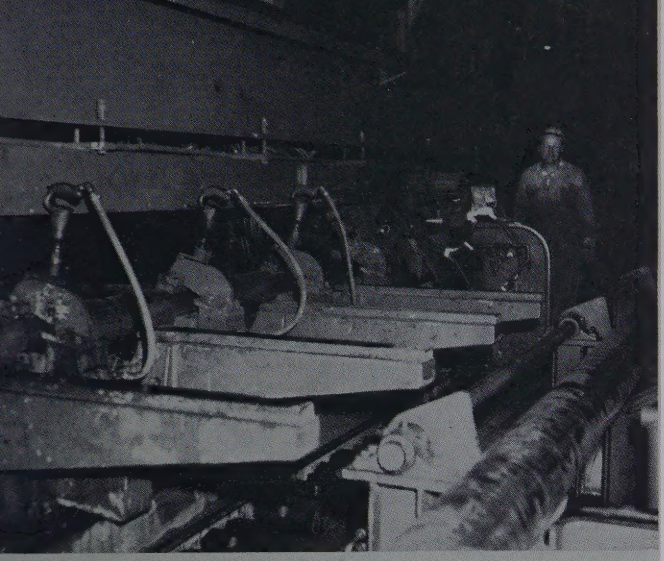


The 55° spillway tunnel was driven with BBD46 stoper drills operating from a Swedish-made Alimak raise climber. A 7 x 7 ft. pilot raise was driven the full 330 ft. Then, from the bottom—midway in the diversion tunnel — the full heading was stoped out. The shrink-stope method was used for both the shaft and the full heading.

Rock was broken into the pilot shaft on the footwall side. Muck removal after each round was limited to about one-third of the total rock broken, so that the men and machines could work from the solid top of the muck pile. When the drilling was completed, the muck pile was removed from the diversion tunnel with heavy mucking equipment. Approximately 9,000 cu. ft. of rock was removed from the shaft, which changes in shape and size from a 26-ft. circle at the lower end to a 34-ft. ovular form at the top.

Quad's project manager Gianetto claims that the use of the stope technique allowed for faster drilling than with jackhammers; less drill machine set-up time after each round; more accurate hole direction in drilling; a higher safety factor because of the solid rock formation overhead; and substantial savings in mucking time and costs.

Prime contractor for the dam project is Tecon Corporation of Dallas, Texas.



Oil-well pipe, manufactured by Alberta Phoenix Tube & Pipe Ltd., under final test by four Atlas Copco R60 riveting hammers at the company's Edmonton plant.

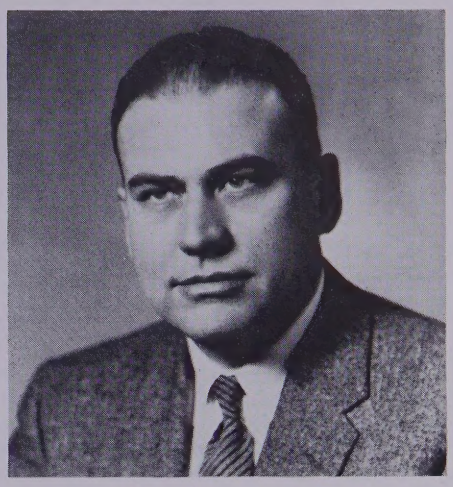
TESTING —
WITH RIVETING HAMMERS

When Alberta Phoenix Tube & Pipe Ltd. delivers its product, the customer may rest assured that the pipe is thoroughly tested and will perform to specifications. This Edmonton-based operation employs about 60 people in the manufacture of commercial steel pipe and specializes in pipe and casings for the petroleum industry. The company receives the sheet in coils, welds the ends together into one strip to permit continuous operations, flattens the sheet, shears it to exact size, rolls it into a tube and welds it with a high-frequency welder, reduces it to size, straightens it and cuts it to required length. This production process—over-simplified in this editorial version—produces pipe ready for testing.

First test is by ultrasonic radio waves for flaws in the metal or the weld. Then samples are crushed to determine if the pipe will break under pressure. Next it is water-tested under a pressure of 3,000 psi. Finally, four Atlas Copco R60 general-purpose riveting hammers are put to work on the weld. In this process, the four guns operate on 62-ft. lengths of the pipe which may range in diameter from 3½ in. to 16 in. The guns operate on each length for 10 seconds, delivering about 175 impacts. The pipe is then tested again under water pressure — and if it survives this test, it is certain to meet any operating requirements.

Before introducing the riveting hammers, Phoenix used hammers with air cylinders for the test, but found it difficult to achieve the necessary number of impacts. Some companies in the industry use chipping hammers for the purpose but, in almost two years of operation, Phoenix has concluded that these general-purpose riveting hammers have many advantages. The company has capacity for 1 million to 1.5 million tons of pipe per year.

New Managing Director Named at Atlas Copco



Russell G. Chambers, P. Eng.

Russell G. Chambers has succeeded A. Harry Grevby as President and Managing Director of Atlas Copco Canada Ltd., effective May 15, 1963. Mr. Grevby, who has been Managing Director since January 1961, returns to Stockholm to assume the new post of Director of Corporate Planning for the world-wide Atlas Copco Group. Mr. Chambers comes back to Canada after more than two years as Vice-President, Sales, Eastern Division of Atlas Copco, Inc., the United States member of the Group.

Russ Chambers joined Atlas Copco Canada Ltd. in 1951, two years after the Company entered Canada. A World War II pilot and instructor, he was graduated from McGill University with a degree in Mining Engineering. Mr. Chambers worked with Asbestos Corporation before joining Atlas Copco. With this Company he has been district manager at the Lakehead and at Kirkland Lake; manager of the head office mining equipment sales division; and western superintendent at Vancouver.

Mr. Chambers is a member of the Engineering Institute of Canada, the Canadian Institute of Mining and Metallurgy, and the American Institute of Mechanical Engineers.

A. Harry Grevby

As Director of Corporate Planning, Harry Grevby will co-ordinate the Atlas Copco Group's world-wide planning activities, aiming toward fulfillment of its growth policies and objectives. Before assuming his position with Atlas Copco Canada Ltd., he was Managing Director of Atlas Copco Belgique in Brussels. Born in Sweden, he took his final engineering examinations in 1938, and until 1943 worked with Sweden's largest contracting firm, Skanska Cementgjuteriet. He then joined the Atlas Copco organization. Following a period with the Anglo-Iranian Oil Co. on its post-war reconstruction projects, he returned to the Group in 1947, becoming manager of the sales group for mining equipment. In 1952, he was appointed manager of portable compressor sales, holding this position until he joined the Belgian company in 1959.

Sweden's Industrial Employment System

Geographically, industrially and economically there is a great deal of similarity between Sweden and Canada. Many Canadians have exhibited an interest in the labor relations processes which, with the exception of the recent strike which turned Sweden into a "dry" country, have worked so well in Sweden.

In the autumn of 1962 the United States Secretary of Labor invited a representative Swedish group to attend the President's Advisory Committee on Labor Management Policy in Washington, D.C. In the hope that Canadian executives will find it interesting, we reproduce here a précis of a statement made to this committee.

by **Ernst N. Michanek**
Under Secretary, Department of Labor, Stockholm

As an introduction to the subject "Industrial Relations and Labor Market Policies in Sweden", I shall try to give you an idea of the atmosphere in which we, i.e., the government, management and workers, view our employment problems.

My first point is that in Sweden all parties support full employment as a primary aim of our economic policies, and as a means of improving the nation's living standards.

Private enterprise plays a dominant role in the Swedish economic system. Over 90 per cent of our industry is in private hands. We all agree on the need for full employment, and we concur in the opinion that the government has a high degree of responsibility for attaining and maintaining full use of our productive facilities.

Unemployment, in other words, is not accepted as a part of our economic policy. And, generally speaking, our unemployment rate during the past two decades has ranged as low as one to two per cent.

Efforts to spur productivity

Our manpower resources have been almost fully utilized for a long time and today we have no important reserves. Emigration is insignificant, and there is some immigration. One possible manpower reserve is represented by the married women, but of this group 40 per cent are already gainfully employed. Older people and partially handicapped citizens may constitute another manpower resource.

We must increase the productivity of the individual worker, of industry itself, and of our national economy as a whole. Our policies include inducements for greater private capital investment, primarily through tax legislation. The rules permit a rapid depreciation of machinery and inventories, which promotes economic growth by encouraging reinvestment of profits.

Management and labor are in agreement as to incentive wage systems. Automation and technological advances are welcomed by both parties. There is no artificial tariff protection of industries with inadequate productivity; we already have low import duties and favor even lower ones.

This situation inevitably creates an inflationary pressure, because of the improved purchasing power of a fully-employed labor force. By means of social welfare measures and private insurance, an increase in purchasing power is also spread to other groups such as the elderly and the infirm. We do not feel that we have been successful enough in fighting inflation, but we believe that the most important thing in this connection is that Sweden's capacity to hold its own in international competition has not been reduced. Nearly one-fourth of our entire production is exported, and our foreign exchange reserves have increased at about the same rates as our imports.

Production costs

My next point concerns the question of how to keep wages and other production costs within the framework of a rising productivity and tolerable price levels. I am tempted to say that, in a private enterprise economy like ours, this is none of the government's business, but a problem for labor and management only. A few facts, however, must be added. There is no legislation on wages in Sweden, no minimum wage law, no legislative provisions regarding overtime pay. We have, on the other hand, a law providing three-week vacations for all employees, which will soon be increased by a fourth week. There is also provision for a 45-hour work week for all wage and salary earners, including those in commerce and agriculture. If the unions agree, however, working hours can be set at any level.

Collective bargaining

We have a national mediation service, but no compulsory arbitration. During the past 15 years the government has felt obliged to intervene in only a few special cases. Management and labor are free to fight out their differences.

Almost all workers in Sweden are now covered by collective agreements — and most such labor contracts are concluded without any kind of government interference, even in the form of mediation.

The government, in other words, does not want any role in decisions on wage matters. It refrains even from laying down guide-lines regarding wages.

On the other hand there is close co-operation among government, labor and management in the collecting of economic information. As a rule such data are not disputed, but the conclusions to be drawn from them are left to the negotiating parties.

At the same time — and this is important — the government tries to pursue economic and social welfare policies that eradicate, or at least alleviate, poverty, insecurity, and social disorder. This cannot always be done in agreement with both management and labor, but most of the time there are no serious differences of opinion.

Labor contracts

There is no official registration of trade organizations, either on the labor or on the management side. Such a system is not needed, since unions have long been accepted by management. The right to bargain collectively is protected by legislation, and, once concluded, a contract can also be enforced by law. In other words, when a contract has been signed, both parties are obliged to live up to it.

Disputes concerning the interpretation of a valid contract are referred to the Labor Court, the eight members of which include management and labor representatives, as well as professional judges. Workers who resort to wildcat strikes and employers who do not abide by a contract can be sentenced to damages. The decisions of the Labor Court are, as a rule, unanimous. There is no appeal to a higher court. The parties to collective contracts are legally obliged to take action against members who do not comply with the provisions of a contract in force.

When workers and employers discuss the terms of new contracts, on the other hand, there is no limitation on their freedom. They still may declare strikes or lockouts if they believe such actions would serve their interests.

Comprehensive voluntary agreements

Sweden has, therefore, very little legislation regarding working conditions and wages. Labor and management have, on the other hand, supplemented the public laws with a system of mutual private agreements. In many cases such co-operation has, in fact, made legislation superfluous. Thanks to the legal protection of collective agreements, there is, as we often call it, a large measure of "legislation by consent" concerning labor relations.

Participation in government

Both management and labor form part of the democratic system of government in Sweden. Important proposals concerning economic and social welfare policies are prepared by committees appointed by the government, and on these, employers and unions invariably have representatives of their own. All reports of such committees are printed, including the full discussion, possible dissenting opinions, and the facts upon which the conclusions are based. The reports are then sent to interested organizations and agencies for their written comments. When the final government bills are introduced in parliament, the entire preceding discussion is set forth in the documents.

Management and labor are also directly represented in the national administration. Each government division dealing with labor and social welfare

has an administrative board and, within the framework of legislation and the budget appropriations, these boards enjoy a considerable degree of independence. On the board for employment policy questions, i.e. the Labor Market Board, as well as on the boards for workers' protection and for social insurance, the central organization of both labor and management are represented. They also have delegates on the board for vocational education, on boards governing social security funds, and on the Council of Economic Planning. Both management and labor are represented at regional levels of the government.

Selective measures further high employment

The fullest possible use of manpower requires, of course, a high degree of mobility and adaptability. Economic and fiscal policies, designed to further a balanced growth and to check inflationary tendencies, must be supplemented by selective employment measures. The National Labor Market Board and its labor exchange service have at their disposal various means of this type.

These agencies can promote the geographical mobility of workers by financial assistance in helping them to move from one working locality to another. They can increase the occupational flexibility by the organization and financing of training and retraining courses. As the employment situation changes, they may call upon various government agencies to make investments in the construction of schools and training institutions, roads, waterways, and other public facilities. They may also undertake such projects themselves.

When the employment situation demands it, the Labor Market Board can call for an increase in public credit for housing construction. The public labor market authorities, moreover, assist both private firms and public institutions in finding the plant locations most suitable from the viewpoint of manpower supply, and they can organize vocational training as well as housing construction if such measures are needed to get new establishments started. They also receive advance notice of important layoffs or reductions in the working force, and then take action to prevent unemployment due to such changes.

The same authorities organize training, rehabilitation and establishment of private or public workshops for the handicapped, for older people, and for institutional cases. They provide retraining for married women who want to return to work after their children have grown up. In the field of construction, they co-operate with private enterprise in order to cut or eliminate seasonal unemployment. The government, for its part, tries to co-ordinate public investments with private activities by proper timing.

Grouting for Tadoussac lighthouse base was carried out by a conveyor belt linking the barge to the caisson.

Shoals at Mouth of Saguenay

Guarded by Caisson Lighthouse

One of the most hazardous parts of the St. Lawrence River is the stretch which passes the mouth of the Saguenay, near Tadoussac below Quebec City. There, swirling underwater currents from the two rivers and the effect of the tides make for tricky navigation. Added to this are frequent fogs in the summer months. Reference points on shore, 4½ miles distant, make it difficult for ships to get an exact fix.

A particularly treacherous point is Prince Shoal, which has been marked by an old lightship. But the ship could not be anchored exactly on the shoal, and the Department of Transport decided to locate a lighthouse there, as a navigational aid.

The very difficulties that created the need for the lighthouse, made its construction impossible by the usual method of pouring a concrete base. Prince Shoal is a tiny tongue of land covered by several feet of water, and the currents that rush over it are strong and unpredictable as to direction and force.

The decision taken was to sink a steel caisson filled with stones and concrete, and to anchor it with another fill of stones and concrete between the caisson and a protective sheath of steel piling. This is not an uncommon maritime operation, but it was appreciated that the combination of underwater conditions and extremely bad weather would present many unusual hazards.

So, last summer, people on the shores of the St. Lawrence were surprised to see a huge, spool-shaped metal tower being towed slowly downriver.

Caisson construction

The steel caisson, 76½ ft. high, 90 ft. in diameter at base, 25 ft. at center and 65 ft. at the top, was built by Louis Donolo Ltd. in the Champlain drydock at Lauzon, across the St. Lawrence from Quebec City. More work was done on it after its delivery to the general contractor for the project, Janin Construction

Ltd., in Quebec City. This included fixing a temporary mooring wharf to the caisson for the boats which would bring men and materials after the caisson was in position. At this stage, also, the tubing system for grouting concrete was installed. It was at Lauzon, too, that the equipment which would drive the piling for the protective sheath was installed on top of the caisson. This was a ¾-cu. yd. Bucyrus-Erie crane with a McKiernan-Terry hammer. Air for the hammer was supplied by a central reservoir fed from three compressors, the largest of which was an Atlas Copco PR rotary screw delivering 620 cfm.

Before the caisson could be sunk, the contractors had to prepare a bed for it on the rocky shoal, and this proved particularly difficult. The requirement was to level an area 250 ft. in diameter with a maximum depth of 28 ft. at low-tide level, and to lay gravel to a minimum thickness of 12 in. Work began on June 15, 1962. The craft involved in the operation had to fight storms and fog, as well as the strong and quickly-changing currents.

After being towed into position, the caisson was sunk and work began immediately on filling and grouting, because it could not be left unfilled for more than 24 hours without risk of being shifted by water currents. About 5,300 cu. yd. of washed gravel was poured into the base, and 25,000 bags of cement grouted through it. As the grouting proceeded, another crew began driving 40-ft. Algoma S-8 sheetpiling into the riverbed around the caisson. While it was under construction, half-sheetpiles had been welded to each rib of the caisson to act as guides.

The sheetpiles were leveled at 20 ft. below low water, and protective steel cover fitted to join the sheathing to the caisson. Five-inch holes were drilled in the cover, and 1,000 bags of cement were poured into the space between the two, by a pneumatic conveyor.

The piles were driven by a No. 7 hammer down to water level, and a No. 9 below water. When worked below water, the hammers were guided by four divers from International Underwater Contractors, who worked round the clock in 12-hour shifts.

To speed the pile-driving, the contractor brought in a second hammer and a Link-Belt crane of 1½ cu. yd. mounted on a landing ship tank (LST). This hammer was fed from the same air supply as the one mounted on the caisson, and it was intended to use both down to water level.

Work was finally completed, and building of the lighthouse began. This summer, it will be flashing out its warnings to ships, and speeding navigation up and down the great St. Lawrence waterway.

The caisson lighthouse base is in its permanent location in the St. Lawrence River off Tadoussac, Quebec. Piles, driven with the aid of an Atlas Copco compressor for the protective sheathing, are visible in foreground.

TEST MINE : EQUIPMENT PERFORMANCE DEVELOPED UNDER ACTUAL OPERATING CONDITIONS

Performance is built into compressed air machines by Atlas Copco through extensive testing under operating conditions in its unusual, if not unique, test mine at Stockholm, Sweden. This has proved its merit not only for experiments, but also as a site for training courses.

Sixty feet below the floor of one of the Atlas Copco factories in Sweden, is a test mine where equipment designed for the world's mining camps is put through its paces under actual operating conditions. These facilities augment the normally rigid chemical, physical and inspection tests that are commonly carried out by manufacturers in factory workshops.

The company has found that acceptance trials and power recording for the development of new machines can best be carried out on stone blocks in the factory test rooms. In these rooms, closely controlled conditions permit accurate net figures for machines tested for performance under varying air pressures, rock formations and bit gauges.

Operating conditions

The workshops, however, are not adequate for operations under working conditions — for example, the drilling of long holes, investigations into ancillary equipment such as chain feeds, and actual comparisons between different types of machines. To solve this problem, Atlas Copco has built a test mine where performance can be built into machines through extensive testing under operating conditions. This unusual, if not unique, mine has been in use for more than 20 years. During this period, it has proved its value not only for experimental purposes, but also for training courses for drillers and engineers. It also serves as a demonstration area for visitors.

Layout of mine

The test mine is approached through a 60-ft.-deep timbered shaft, 10 x 7 ft. in size. A cage with counterweight is housed in one half of this shaft, while in the other half there are pipelines and a manway. In addition, there is a 10 x 10 ft. shaft for materials through which all machinery and equipment is lowered, and the broken rock hoisted to the surface. An automatic pump effects drainage from a water basin under the shaft. The drifts now have a total length of about 1,640 ft. There are also two galleries, each 20 x 26 ft. in area, which are used for testing all ancillary equipment, drill wagons, etc.

Compressed air at pressures from 180 psi downwards is available in the mine. There is also a water supply ranging in pressure from 40 to 100 psi. Electrical installation of sufficient power to supply light for photographing and filming has been made.

Rock formation

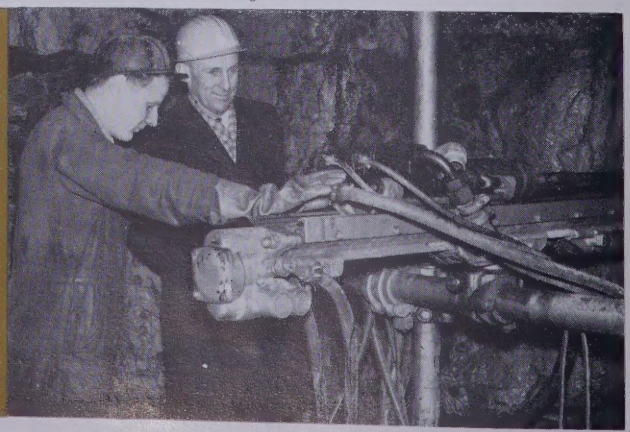
The rock consists of a recent, partly-converted granite formation. From the point of view of "drillability", the granitic portions and the pegmatite veins are medium-hard, while the metamorphic formations are softer.

The test mine has proved of most value in the development of various ancillary devices for underground drilling, as it provides conditions corresponding closely to actual working sites. Extensive drilling operations have been carried out with various types of pusherleg equipment, and comparative time studies have also been held.

The first experiments with new methods for blasting cuts in drifts 7 x 7 ft. in size, specially suited for pusherleg machines and tungsten carbide-tipped drill steels, were undertaken in this mine.

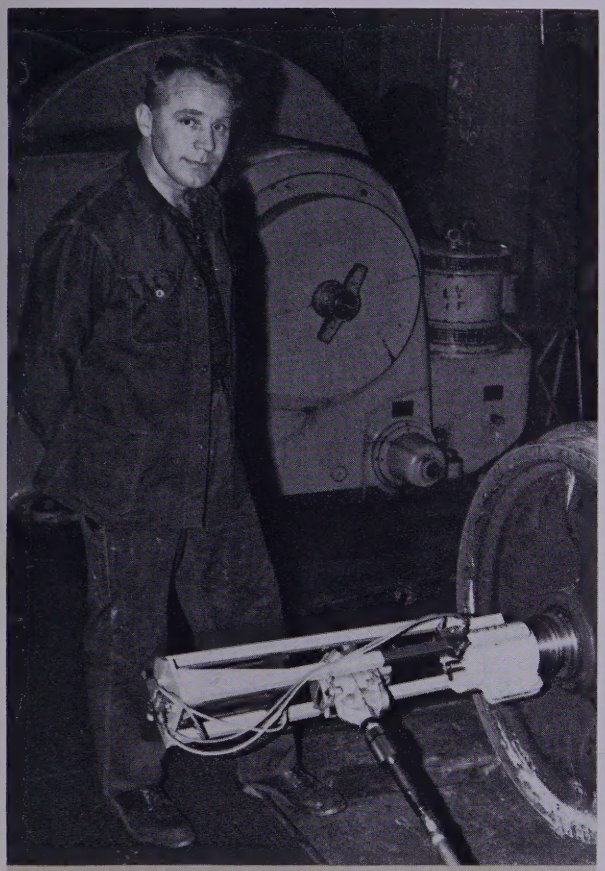
Sixty feet below city streets in Stockholm an Atlas Copco T2G autoloader is put through its paces in the company's test mine. Mine is a mecca for visiting miners.

W. J. Shaver of Lamaque Mine in northwestern Quebec visited the mine early in 1963 while in Sweden to address the Swedish Mining Association on AN/FO blasting.



Atlas Copco

AROUND THE WORLD

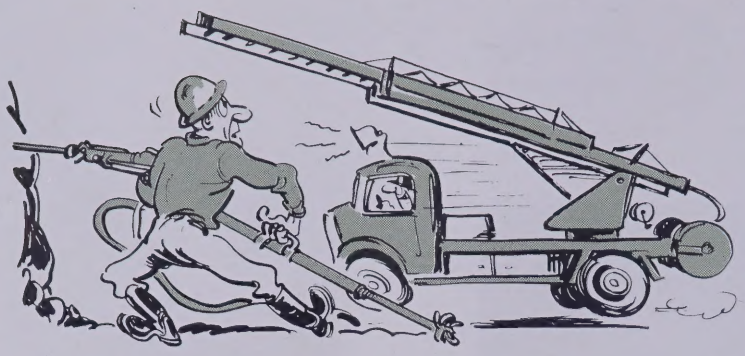


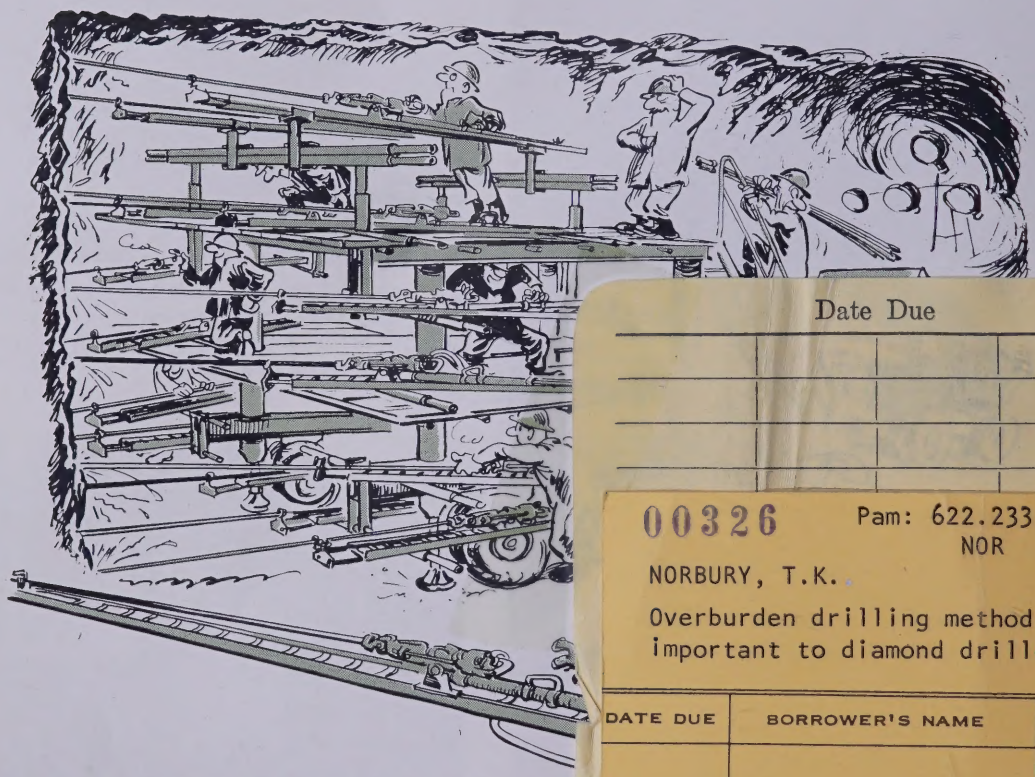
Norwegian State Railways reduced to one-third the time required for changing journals on 9,000 wheel sets with a fixture incorporating an Atlas Copco RAB12L drill. The fixture is attached to each wheel and the operation completed without removing the wheel sets from the pits. One man easily moves the lightweight fixture and fits it into position.

Venerable Edinburgh Castle was showing dangerous inhospitality when rock supporting it began to deteriorate and fall below. A combination of Atlas Copco light rock drills and mine roof bolts solved this safety problem.

With Belgium's motor traffic increasing about 10 per cent a year, Brussels is keeping down traffic snarls by widening and resurfacing its streets. Quaint, narrow streets bordered by old Flemish-style houses are disappearing, and cobblestones are giving way to modern pavement. Light, compact and mobile Atlas Copco VT4 compressors are well suited to such repair work, which has to continue under high-density traffic conditions.

Geoff Garden, a fourth-generation Garden in the toolmaking trade in New South Wales, Australia, grinds land around thread of bottle mold with TS2F6H pneumatic grinder, powered by KT4RAS compressor. Equipment paid for itself in first four months of operation.





IDEAS & INTERPRETATIONS

Ideas are the fuel of progress. A few years ago Atlas C
introduced to Canada a new idea called ladder drilling
method of using pusherleg drills mounted on ladders to ac
more accurate, faster and less costly advances in tun
work. Meanwhile, a Canadian artist called "Ricky," wh
famous industrial cartoonist in Europe, has interpreted th
in the manner shown above. Contractors, from coast to
interpret it—correctly—as both a time and money-saving

Atlas Copco

Rock Drills • Diamond Drills • Drill

St. John's, Nfld. • Truro • Sept-Iles • Qu
Timmins • Sudbury • Port Arthur-Fort